Space Weather Technical Forecast

Issued on Wednesday 12 February 2025 at 12:36 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of Isolated M-class flares. Chance G1 Minor Storms, most likely late Day 1 into Day 2 (12-13 Feb) due to coronal hole high speed stream.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with no significant flares. There are six sunspot regions currently on the visible disc, however these are generally small and simple. AR3990 in the southeast, is perhaps the most notable, however this appears to be a mature region dominated by its large leader, with only limited complexity or activity. Newly numbered AR3992 in the centre disk has developed rapidly in both its leader and trailer regions and will need top be monitored for further development, it has been analysed as a simple beta Dai region for now.

No Earth directed CME's were observed from available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds have been elevated between 500km/s and 600km/s, likely due to a connection to CH13/-. Density was near or just below average. Interplanetary Magnetic Field strength, Bt, was weak near 5nT with just a brief increase to near 7nT. The north-south component, Bz, was also weak and variable in direction, slightly favouring negative (southwards-directed) conditions, ranging between -6nT to +6nT. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was mainly Unsettled to Active (Kp3-4).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 persisted at background. High energy electron flux (greater than 2MeV) at GOES16 was Moderate, with diurnal peaks of high, peaking 2080 pfu at 11/1605 UTC. The associated 24-hour fluence persisted below the Active threshold, recording 5.34e7 integrated pfu at 12/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to Low activity expected with a chance of further M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Due to the relatively close proximity of CH13/- and CH14/- the nature of any transition between the high speed streams from each feature is unclear. It is possible winds may ease a little as Earth leaves the influence of CH13 before picking up again when the CH14 HSS arrives, most likely later day 1 or early day 2 (12-13 Feb). The latitudinally elongated nature of CH14 suggests that once these fast winds arrive they will continue through the period. Initially Quiet to Unsettled geomagnetic activity with Active

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intervals forecast by the end of Day 1 (12 Feb) with a chance of G1 Minor Storms, most likely with the transition into CH14 Days 1-2 (12-13 Feb), and any CIR region that is observed.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background. High energy electron flux observed at GOES16 is expected to see a gradual rising trend, both at first and again later in the period, with the likelihood of periods of High flux. There is a chance for the corresponding 24-hour fluence to rise above the Active threshold during Day 1 (12 Feb) likely returning below the Active threshold by Day 2 (13 Feb). A chance of electron fluence then rising above the Active threshold again from Day 3 (14 Feb).

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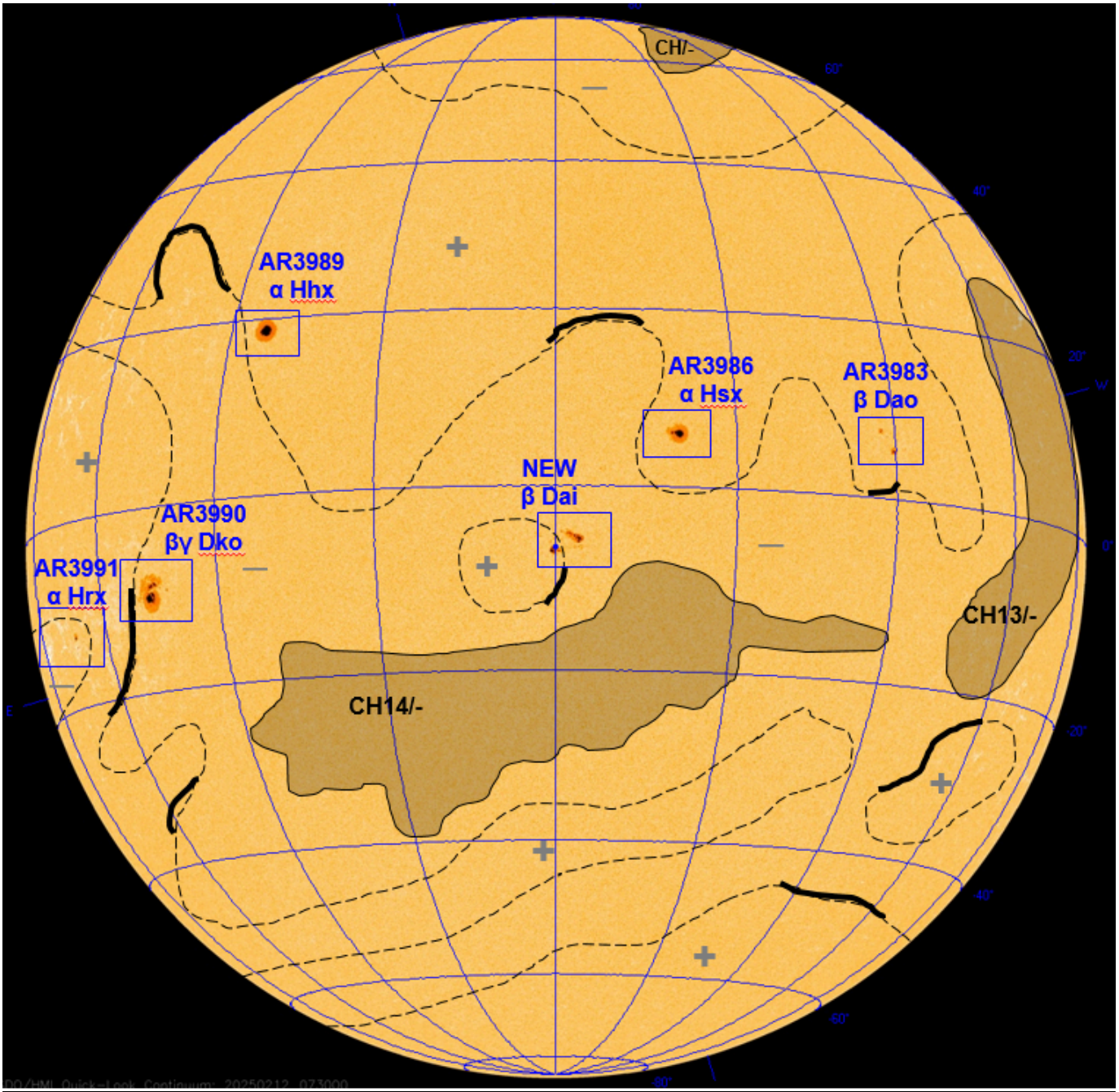
Figure 1: Solar synoptic analysis 12/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

While there have been a few notable CMEs from the eastern limb, they are not Earth-directed and are unlikely to bring any enhancement to Earth.

Ongoing fast winds from CH13/- may ease a little through the remainder of Day 1 (12 Feb) before the next enhancement from CH14/- arrives later Day 1 (12 Feb) and into Day 2 (13 Feb) from a connection to the high speed stream from CH14/-. This is an elongated feature across a similar latitude to Earth's current heliographic projection. Any subsequent enhancement from this feature is low confidence in terms of the timing of onset, but is likely to become Elevated to Strong (500-600km/s) by Day 2/3 (13/14 Feb), before persisting at this level throughout the current forecast period. This is supported by MOSWOC Enlil, which is showing elevated to strong winds through the period.

Unsettled to Active conditions expected through the period, with a greater chance of Quiet periods from late Day 3 (14 Feb) onwards. However, there is a chance of isolated G1 intervals throughout due to the ongoing fast solar winds, but most likely with the onset of CH14/- later Day 1 or early Day 2 (12-13 Feb).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	50	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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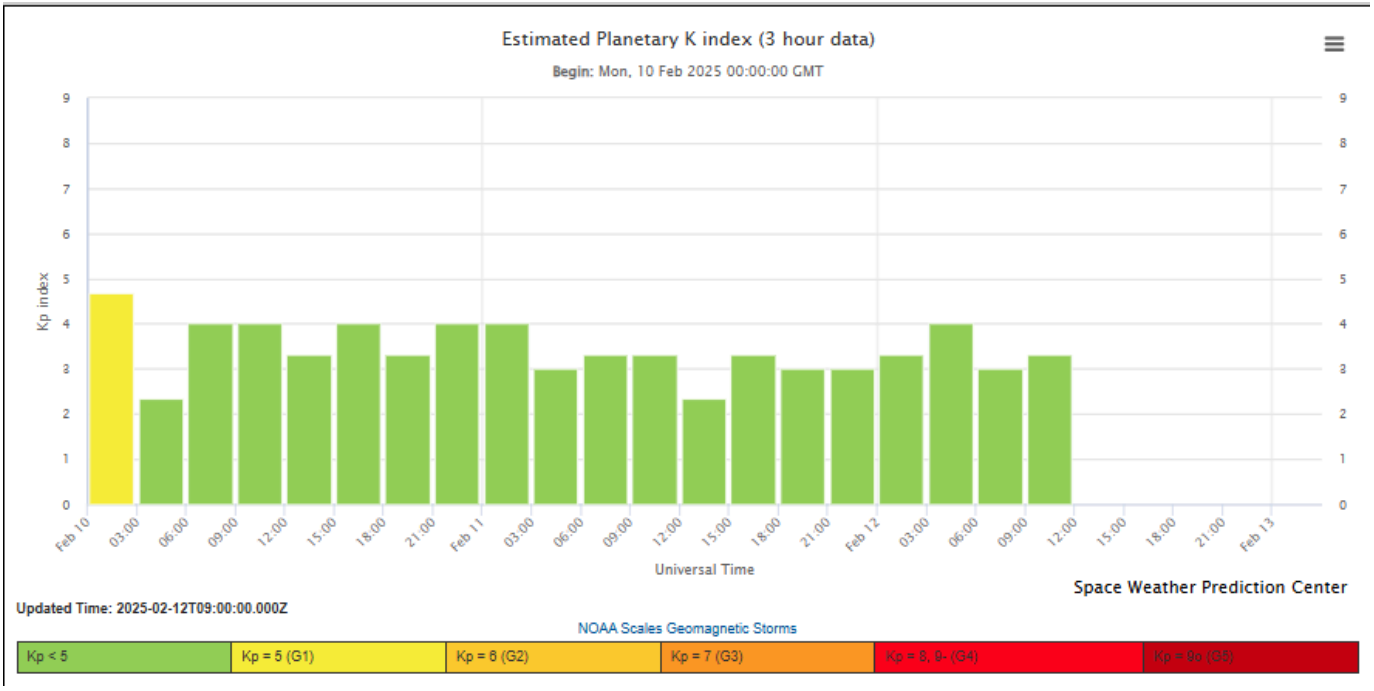
Figure 2: NOAA/ SWPC Estimated Planetary K index


Estimated Planetary K index (3 hour data)
Begin: Mon, 10 Feb 2025 00:00:00 GMT
Kp index
Universal Time
Space Weather Prediction Center
Updated Time: 2025-02-12T09:00:00.000Z
NOAA Scales Geomagnetic Storms
Kp < 5
Kp = 5 (G1)
Kp = 6 (G2)
Kp = 7 (G3)
Kp = 8, 9- (G4)
Kp = 9o (G5)

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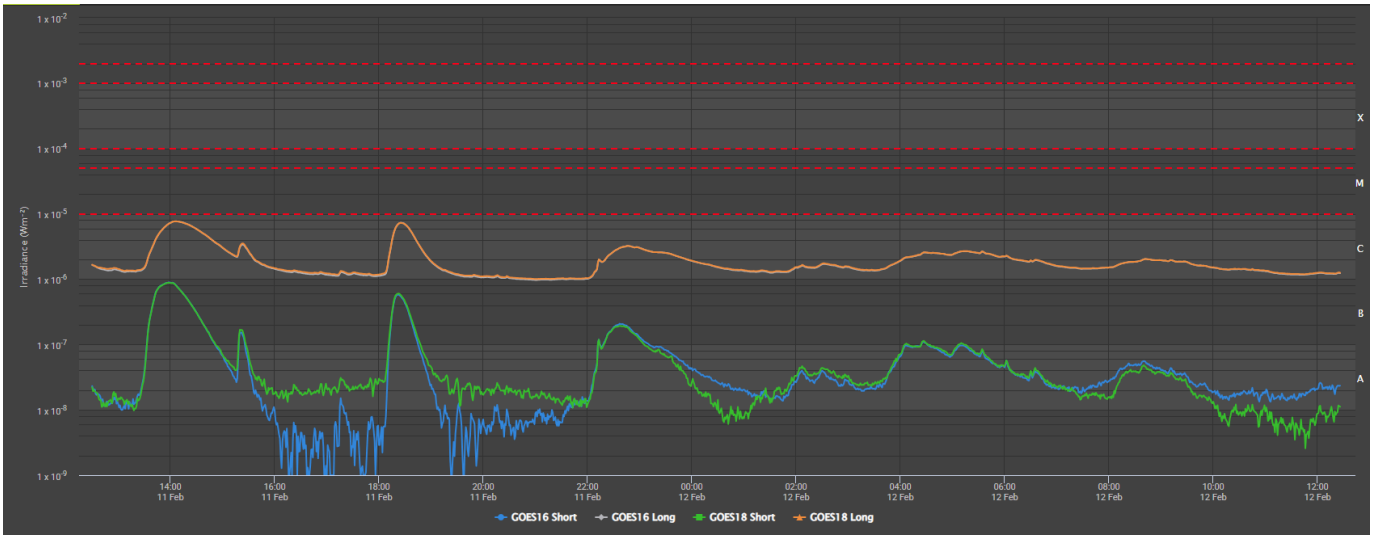
Radio Blackouts - X-Ray Flares

Solar activity has been low in the last 24 hours, with no significant flares observed. Solar activity is likely remain at low to moderate levels with a chance of isolated M-class flares. A slight increase in probabilities through the period as new regions rotate on to the eastern limb in the coming 48 hours and if AR3992 continues to develop into a magnetically complex feature.

There are six sunspot regions on the disc, with the most notable of these AR3990 in the southeast. This is comprised predominately of a large and likely mature leader spot, set within a broad area of plage, and followed by a small trailer. This region has remained relatively inactive so far. The other regions remain smaller and simpler, though as mentioned AR3992 has developed rapidly and will be monitored for signs of complexity. SDO imagery does indicate further clustered magnetic looping beyond the east limb, and recent CMEs from the eastern limb, which could relate to a number of returning regions that could potentially move onto the disc during this period. This is also supported by far-sided sources. This remains low confidence at this stage.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	40	50	50
Very Active	R3-R5 (X Class)	No	1	1	5	5

Figure 3: GOES18 X-Ray flux



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Solar Radiation Storms (High Energy Protons)

GOES-16 proton flux is forecast to persist at background with only a very slight chance of enhancement from any notable flares. AR3981 is now moving further away from the northwest limb, though some notable magnetic looping is still evident from this region. As this continues to rotate further on to the far-side of the disc, the risk of a proton rich flare significantly decreases. Other sunspot regions remain relatively simple and benign.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been largely Moderate with diurnal peaks to high. The ongoing enhancement from CH13/- fast winds is expected to have charged the Van Allen belts for lower orbits, leading to the observed flux rising as winds ease a little and this charge migrates out to GEO. This picture is complicated, however, by the expected further connection to CH14/-, most likely occurring either late Day 1 or Day 2 (12-13 Feb), with the associated onset and any geomagnetic activity likely suppressing the observed flux for a time, before a further rise is expected Day 3 (14 Feb).

There is a chance for the corresponding 24-hour fluence to rise above the Active threshold during Day 1 into Day 2 (12-13 Feb) and is represented by MOSWOC REFM which is giving reasonable guidance at present. Any geomagnetic activity associated with the onset of the fast winds from CH14/- may see a temporary dip in electron flux and therefor fluence on Day 2 (13 Feb) before rising again by Day 3 (14 Feb).

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	40	20	30	30
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: GOES16 ElectronFlux (3 day trace)

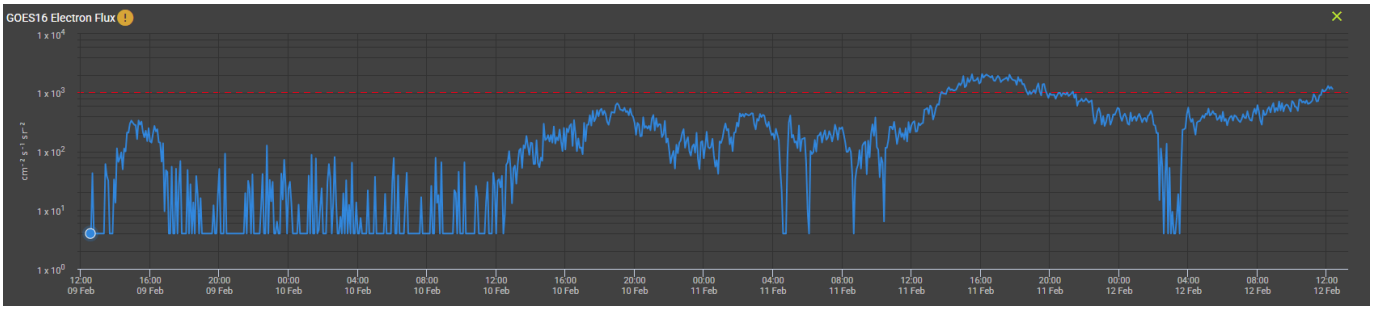

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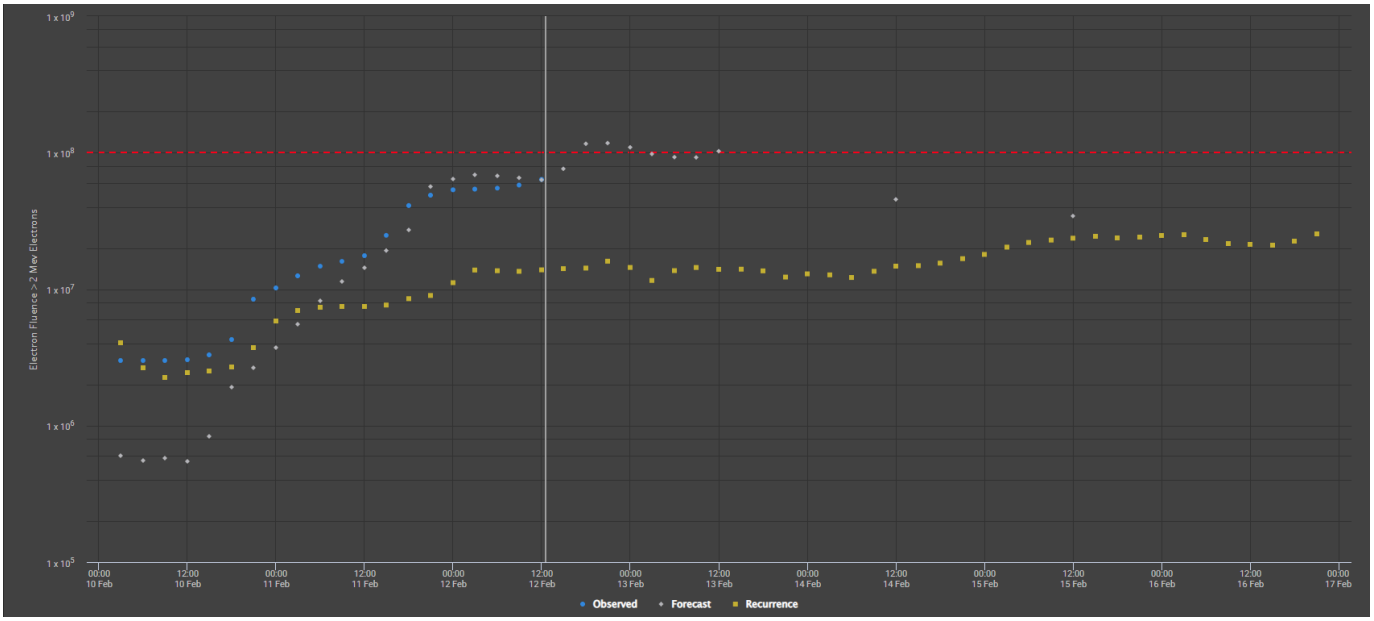
Figure 5: MOSWOC REF Model



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